

### ABSTRACT OF THE DISCLOSURE

In correcting the sound field, the loudspeakers  $6_{FL}$  to  $6_{WF}$  are sounded by the noise. The attenuation factors of the inter-band attenuators  $ATF_{11}$  to  $ATF_{ki}$  for adjusting gains of the band-pass filters  $BPF_{11}$  to  $BPF_{ki}$  to the frequency in respective channels are corrected based on detection results of the reproduced sounds of the loudspeakers  $6_{FL}$  to  $6_{WF}$ . Then, the attenuation factors of the channel-to-channel attenuators  $ATG_1$  to  $ATG_5$  are corrected based on the detection results of the reproduced sounds of the loudspeakers  $6_{FL}$  to  $6_{WF}$ . Then, the delay times of the delay circuits  $DLY_1$  to  $DLY_5$  are corrected based on the detection results of the reproduced sounds of the loudspeakers  $6_{FL}$  to  $6_{WF}$ . Then, the attenuation factor of the channel-to-channel attenuator  $ATG_k$  is corrected based on the detection result of the reproduced sound of the loudspeaker  $6_{WF}$  as the subwoofer, whereby the levels of the reproduced sounds reproduced by the loudspeakers  $6_{FL}$  to  $6_{WF}$  are adjusted to be made flat over the audio frequency band.

FIG.1:

- (1) sound source 1
- (2) signal processing circuit 2
- (3) noise generator 3
- (4) D/A converter  $4_{FL}$ ,  $4_{FR}$ ,  $4_C$ ,  $4_{RL}$ ,  $4_{RR}$ ,  $4_{WF}$ , 10
- (5) amplifier  $5_{FL}$ ,  $5_{FR}$ ,  $5_C$ ,  $5_{RL}$ ,  $5_{RR}$ ,  $5_{WF}$ , 9
- (6) A/D converter 10

FIG.2:

- (1) noise generator 3
- (2) attenuator  $ATF_{11}$ ,  $ATF_{12}$  to  $ATF_{1j}$ ,  $ATF_{k1}$ ,  $ATF_{k2}$ ,  $ATF_{ki}$ ,  
 $ATG_1$ ,  $ATG_2$ ,  $ATG_3$ ,  $ATG_4$ ,  $ATG_5$ ,  $ATG_k$
- (3) delay circuit  $DLY_1$ ,  $DLY_2$ ,  $DLY_3$ ,  $DLY_4$ ,  $DLY_5$ ,  $DLY_k$

FIG.3:

- (1) frequency characteristic correcting portion 11
- (2) channel-to-channel level correcting portion 12
- (3) phase characteristic correcting portion 13
- (4) flatness correcting portion 14
- (5) system controller MPU

FIG.4:

- (1) middle/high frequency band processing portion (except subwoofer) 15a
- (2) low frequency band processing portion (except subwoofer) 15b
- (3) subwoofer low frequency band processing portion (only subwoofer) 15c

- (4) calculating portion 15d

FIG.5:

- (1) logarithmic frequency (kHz)
- (2) gain (dB)
- (3) low frequency band
- (4) middle/high frequency band

FIG.6:

- (1) logarithmic frequency (kHz)
- (2) power (dB)
- (3) low frequency band
- (4) total power of loudspeakers  $6_{FL}$  to  $6_{WF}$
- (5) power of loudspeakers  $6_{FL}$  to  $6_{RR}$
- (6) power of a loudspeaker  $6_{WF}$

FIG.7:

- (1) front left-side loudspeaker  $6_{FL}$
- (2) center loudspeaker  $6_C$
- (3) front right-side loudspeaker  $6_{FR}$
- (4) rear left-side loudspeaker  $6_{RL}$
- (5) subwoofer  $6_{WF}$
- (6) rear right-side loudspeaker  $6_{RR}$

FIG.8:

- (1) start
- (2) frequency characteristic correcting process (S10)
- (3) channel-to-channel level correcting process (S20)
- (4) phase characteristic correcting process (S30)

- (5) flatness correcting process (S40)
- (6) end

FIG.9:

- (1) start
- (2) initialize the attenuators (S100)
- (3) measure the sound field characteristic (S104)
- (4) set a target curve (S106)
- (5) calculate adjusted values  $F_n(x, J)$  (S110)
- (6) normalizing process (S120)
- (7) calculate the attenuation factors  $S_{Fxj}$ ,  
adjust the attenuation factors of the inter-band  
attenuators (S126)
- (8) end

FIG.10

- (1) start
- (2) initialize the attenuators (S200)
- (3) measure the sound field characteristic (S204)
- (4) Have processes of the channels 1 to 5 been completed  
 $x=5$  ? (S208)
- (5) set target data (S210)
- (6) calculate adjusted values of the channel-to- channel  
attenuators (S212)
- (7) adjust the channel-to-channel attenuators (S214)
- (8) return

FIG.11:

- (1) start
- (2) initialization (S300)
- (3) measure the sound field characteristic (S304)
- (4) Have processes of all channels been completed  $x=k$  ?  
(S308)
- (5) calculate delay times (S310)
- (6) calculate the average delay time (S316)
- (7) adjust the delay circuits (S318)
- (8) return

FIG.12:

- (1) start
- (2) set parameters (S400)
- (3) set target data (S402)
- (4) initialize the attenuator on the subwoofer channel  
(S404)
- (5) measure the sound field characteristic (middle/high  
frequency band of 5 channels) (S406)
- (6) measure the sound field characteristic (low frequency  
band) (S408)
- (7) measure the sound field characteristic (only  
subwoofer) (S410)
- (8) calculate the attenuator adjusted value on the  
subwoofer channel (S412)
- (9) adjust the attenuator on the subwoofer channel (S414)
- (10) return